REMARKS/ARGUMENTS

Favorable consideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1, 2, 4, 5, 7-10, 12, 13, 15-18 and 20-26 are presently pending in this application, Claims 3, 6, 11, 14 and 19 having been canceled, Claims 1, 7, 8, 12 and 15 having been amended by the present amendment.

In the outstanding Office Action, Claims 1-7 and 20 were rejected under 35 U.S.C. §102(b) as being anticipated by JP 09-042595 (hereinafter "JP '595"); Claims 8, 12 and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP '595 in view of Blair et al. (U.S. Patent 6,095,367); Claims 10, 13, 16 and 17 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP '595 in view of Taylor (U.S. Patent 7,093,337); Claims 9, 11, 14, and 18-20 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP '595 in view of Blair et al. and Narita et al. (U.S. Publication 2004/0074949); Claims 21 and 22 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP '595 in view of Narita et al. and Klenk et al. (U.S. Publication 2004/0038094); Claims 23-26 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP '595 in view of Narita et al. and Faye et al. (U.S. Publication 2004/0033402).

Claims 1, 7, 8, 12 and 15 have been amended herein. These amendments are believed to find support in the specification, claims and/or drawings as originally filed, and no new matter is believed to be added thereby. If, however, the Examiner disagrees, the Examiner is invited to telephone the undersigned who will be happy to work in a joint effort to derive mutually satisfactory claim language.

Before addressing the rejections based on the cited references, a brief review of Claim 1 as currently amended is believed to be helpful. Claim 1 is directed to a pressure vessel liner and recites: "a tubular trunk and head plates for closing respective opposite end openings of

the trunk, the trunk having a reinforcing member fixedly provided therein and extending longitudinally of the trunk for dividing interior of the trunk into a plurality of spaces, the head plates being joined to the reinforcing member, wherein the head plates are joined to the reinforcing member by friction agitation, at least one of the head plates is in the form of an outwardly bulging dome, and an end portion of the reinforcing member adjacent to the domelike head plate projects outward beyond the trunk and fitted in the domelike head plate."

It is respectfully submitted that JP '595 does not teach or suggest "a tubular trunk and head plates for closing respective opposite end openings of the trunk, the trunk having a reinforcing member fixedly provided therein and extending longitudinally of the trunk for dividing interior of the trunk into a plurality of spaces, the head plates being joined to the reinforcing member, wherein *the head plates are joined to the reinforcing member by friction agitation,* at least one of the head plates is in the form of an outwardly bulging dome, and *an end portion of the reinforcing member adjacent to the domelike head plate projects outward beyond the trunk and fitted in the domelike head plate*" as recited in amended Claim 1 (emphasis added in italic).

That is, JP '595 describes a liner 2 where a circumferential wall member 3 and die-cast-worked end wall members 4, 5 are connected to each other by weld parts 6. The circumferential wall member 3 includes a cylindrical circumferential wall part 7 and a reinforcement rib part 8 connecting its inner circumferential surfaces to each other, and the reinforcement rib part 8 has three rib plates 9 radially disposed in a cross sectional surface, and pipes 10 connecting inner ends of these to each other. End wall members 4, 5 include an end wall part 11 of sphere form, a mouthpiece portion 12 which pierces through the central part of the end wall part 11, and the three rib parts 13 set up by the inner surface of the end wall part 11. A projection 13a which positions by entering into the inner circumference of the circumferential wall part 7 is formed in the end of the rib part 13. Weld parts 6 weld both

the left and right ends of the circumferential wall part 7 of the circumferential wall member 3, and the periphery edge of the end wall part 11 of each end wall members 4, 5.[1] Nonetheless, JP '595 does not disclose that the end portion of the reinforcement rib part 8 is projecting outward from the circumferential wall part 7, the outwardly projecting portion of the reinforcement rib part 8 is fitted in the end wall part 11 of the end wall members 4, 5, and the end wall part 11 of the both end wall members 4, 5 and the reinforcement rib part 8 of the circumferential wall member 3 are joined by friction agitation from outside the end wall members 4, 5. Therefore, the structure recited in amended Claim 1 is believed to be distinguishable from JP '595.

Likewise, Blair et al., Taylor, Narita et al., Klenk et al. and Faye et al. are not believed to teach or suggest "a tubular trunk and head plates for closing respective opposite end openings of the trunk, the trunk having a reinforcing member fixedly provided therein and extending longitudinally of the trunk for dividing interior of the trunk into a plurality of spaces, the head plates being joined to the reinforcing member, wherein *the head plates are joined to the reinforcing member by friction agitation,* at least one of the head plates is in the form of an outwardly bulging dome, and *an end portion of the reinforcing member adjacent to the domelike head plate projects outward beyond the trunk and fitted in the domelike head plate*" as recited in amended Claim 1 (emphasis added in italic), and the structure recited in amended Claim 1 is also believed to be distinguishable from Blair et al., Taylor, Narita et al., Klenk et al. and Faye et al.

Because none of Blair et al., JP '595, Taylor, Narita et al., Klenk et al. and Faye et al. discloses the structure as recited in amended Claim 1, their teachings even in combination are not believed to render the pressure vessel liner recited in Claim 1 obvious.

[1] See, for example, the attached English translation (machine translation) of JP '595, paragraphs 13-16.

For the foregoing reasons, Claim 1 is believed to be allowable. Furthermore, since Claims 2, 4, 5, 7-10, 12, 13, 15-18 and 20-26 depend directly or indirectly from either Claim 1, substantially the same arguments set forth above also apply to these dependent claims. Hence, Claims 2, 4, 5, 7-10, 12, 13, 15-18 and 20-26 are believed to be allowable as well.

In view of the amendments and discussions presented above, Applicants respectfully submit that the present application is in condition for allowance, and an early action favorable to that effect is earnestly solicited.

Respectfully submitted,

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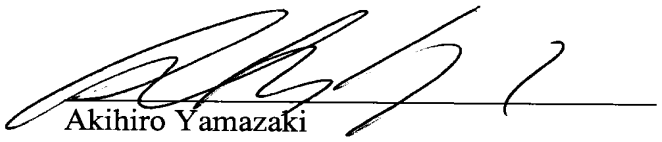

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ATTACHMENT

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the pressure vessel for being filled up with the various qualities of pressurized material of various liquefied gases, such as various compressed gas, such as CNG (compressed natural gas), LNG (liquefied natural gas), and LPG (liquefied petroleum gas), and others.
[0002]
[Description of the Prior Art]In order that the car which uses CNG as fuel may hardly discharge a sulfur oxide and carbon monoxide, development and utilization are advanced energetically these days. There is development of the pressure vessel lightweight and cheap as one of important development themes for CNG restoration.
[0003]The pressure vessel 50 for CNG restoration of the first conventional example shown in drawing 8 is provided with the liner 51 made from an aluminum alloy, and this liner 51 contains the tubed peripheral wall part 52, the end wall part 53 of the sphere form of the both ends, and the regio oralis 54 of the shape of a neck projected outside from the central part of the end wall part 53. While twisting glass fiber around the periphery direction of the peripheral wall part 52, the hoop volume reinforcement layer 55 made from FRP (fiber reinforced resin) which carries out impregnating immobilization with an epoxy resin is formed in the periphery of the peripheral wall part 52. In order to form the liner 51, first, carry out extruding of the aluminum alloy cylinder, and it is cut to standard size, After carrying out bottling processing (spinning), forming the end wall part 53 and the regio oralis 54 and punching the center of this regio oralis 54 until the both ends of this aluminum alloy cylinder are embarrassed, it is carried out in the procedure of heat-treating the whole. Here, the thickness of the liner 51 was about 17 mm so that the internal pressure which reaches also more than 200kg[/cm] ^{2} could be borne.
[0004]Although the pressure vessel 60 for CNG restoration of the second conventional example shown in drawing 9 is provided with the liner 61 made from an aluminum alloy which similarly contains the peripheral wall part 62, the end wall part 63, and the regio oralis 64, the double reinforcement layers 65 and 66 are formed in the periphery. That is, as the end wall part 63 of both sides is started glass fiber, while twisting in the length direction of the peripheral wall part 62, the helical volume reinforcement layer 65 made from FRP which carries out impregnating immobilization with an epoxy resin is formed in the periphery of the liner 61. While twisting glass fiber around the periphery direction of the peripheral wall part 62, the hoop volume reinforcement layer 66 made from FRP which carries out impregnating immobilization with an epoxy resin is formed in the periphery of the helical volume reinforcement layer 65. Although the formation procedure of the liner 61 was the same as the first conventional example, only the part with the helical volume reinforcement layer 65 of the thickness of the liner 61 was thinner than the first conventional example, and was 10-12 mm in 5-6 mm and the end wall part 63 at the peripheral wall part 62. If the thick difference by a part carries out bottling processing of the both ends of an aluminum alloy cylinder with a thickness of 5-6 mm, it will be because thickness increases to 10-12 mm.
[0005]
[Problem(s) to be Solved by the Invention]However, there were the following problems in the above-mentioned conventional example. Since the liners 51 and 61 were the integral construction which

carries out bottling processing after carrying out extruding of the aluminum alloy cylinder as aforementioned, the material of construction was first limited to the specific thing in response to the restrictions on processing. Since mass processing equipment and complicated work were needed, the installation cost and the conversion cost were high. As a result, any pressure vessels 50 and 60 were dramatically expensive, and it had become a problem when aiming at the spread of CNG vehicles.
[0006]It is very difficult for a minimum to be among the thickness in which extruding is possible, and to carry out extruding of the thick thin aluminum alloy cylinder. If bottling processing of the thick thin aluminum alloy cylinder is carried out, it will be easy to generate buckling. When the thickness of the liner 51 was about 17 mm like the first conventional example, the problem of these processings was not produced, but on the other hand, weight was large. Although the thickness of the liner 61 of the second conventional example was thin compared with this, 5-6 mm thru/or 10-12 mm are limits as aforementioned, and there was still indication that weight was still large. Thus, any pressure vessels 50 and 60 had large weight, and when carried in a car, there was a problem of worsening fuel consumption and weight balance.
[0007]The purpose of this invention solves an aforementioned problem and is to enable it to manufacture a lightweight pressure vessel easily and cheaply.
[0008]
[Means for Solving the Problem]To achieve the above objects, a pressure vessel of this invention was provided with a liner at which it comes to connect the metal peripheral wall members by which extruding was carried out, and an another processed metal end-wall member, and a reinforcement layer provided in a periphery of this liner, and said peripheral wall member considered it as composition which contains a peripheral wall part and a reinforcing rib part in one.
[0009]Here, it is 1-3 mm that it is 1-4 mm desirable still more preferably, and thickness of a "peripheral wall member" is 1-2 mm most preferably. A reinforcing rib part will not be limited to a specific structure, if a peripheral wall part can be reinforced, but what connects between inner skin of a peripheral wall part is preferred. If a metallic material of a liner has the corrosion resistance over quality of packing while not making quality of packing penetrate, it will not be limited to a specific thing. As a metallic material of a peripheral wall member, ferrous materials, such as an aluminum alloy material of JIS-A6061, A6010, and MG110 grade, SPCE (cold-rolled steel), SPP (porcelain enamel coated steel), terne-coated carbon steel sheets (lead-tin alloy coated steel board), SUS (stainless steel), can be illustrated. As a metallic material of an end-wall member, Magnesium alloy materials, such as an aluminum alloy material of JIS-ADC1 - 12 grade, JIS-AZ 91A, AZ91B, and zinc alloy material of JIS-ZDC1 and ZDC2 grade can be illustrated.
[0010]As "another processing" of an end-wall member, casting work, press working of sheet metal, etc. can be illustrated. Die-casting processing of casting work suitable for a thick thin thing is preferred, and its vacuum-die-casting processing, laminar flow die-casting processing, AKYURADDO die-casting processing, imperforation die-casting processing, etc. which can lose a blow hole especially are preferred.
[0011]A "reinforcement layer" will not be limited to a specific thing, if it has the intensity which can bear internal pressure, but its reinforcement layer made of fiber reinforced resin which carries out impregnating immobilization by resin is preferred at a point which combines reinforcement nature and lightweight nature while it twists textiles around a periphery of a liner. A helical volume reinforcement layer made of fiber reinforced resin which carries out impregnating immobilization by resin while twisting textiles in the length direction of a peripheral wall member still more preferably, as an end-wall member of both sides is started a periphery of a liner, While twisting textiles around a periphery of a helical volume reinforcement layer in a periphery direction of a peripheral wall member, it consists of a hoop volume reinforcement layer made of fiber reinforced resin which carries out impregnating immobilization by resin.
[0012]If material of "textiles" has reinforcement nature, it is not limited to a specific thing but can illustrate glass, carbon, Polly p-phenyleneterephthalamide, nylon, polyethylene, polyester, etc. A kind of "resin" is not limited to a specific thing, but can illustrate epoxy, vinyl ester, unsaturated polyester, etc.

[0013]
[Embodiment of the Invention]Hereafter, the example of a gestalt which carried out this invention to the

pressure vessel for CNG restoration is explained with reference to drawings. First, drawing 1 - drawing 5 show the pressure vessel 1 of a first embodiment. As the liner 2 of the innermost layer of the pressure vessel 1 is shown in drawing 1, the peripheral wall member 3 made from an aluminum alloy by which extruding was carried out, and the end-wall members 4 and 5 of the right end made from an aluminum alloy and a left end by which die-casting processing was carried out are the cylindrical containers which the weld zone 6 comes to connect.

[0014]As for the peripheral wall member 3, this reinforcing rib part 8 consists of the three rib boards 9 arranged on the section radial, and the pipe 10 which combines the inner end of each rib board 9, including in one the tubed peripheral wall part 7 and the reinforcing rib part 8 which connects between the inner skin of the peripheral wall part 7. Thus, the peripheral wall member 3 is provided not only with the peripheral wall part 7 but with the reinforcing rib part 8, since there is also no necessity of carrying out bottling processing after extruding, even if it is extruding, thickness can be made thinner than before, structurally, intensity is high and thickness of the peripheral wall member 3 is made thin with 1-2 mm.

[0015]As for the right-hand side end-wall member 4, the female screw hole 14 for the piping (graphic display abbreviation) connection for taking CNG is formed in the center of the base part 12, including in one the end wall part 11 of sphere form, the base part 12 which pierces through the central part of the end wall part 11, and the three rib parts 13 set up by the inner surface of the end wall part 11. The projection 13a which positions by entering into the inner circumference of the peripheral wall part 7 is formed in the end of the rib part 13. The left-hand side end-wall member 5 contains in one the end wall part 11 of sphere form, the boss section 15 which pierces through the central part of the end wall part 11, and the three rib parts 13 set up by the inner surface of the end wall part 11. Thickness of each end wall part 11 is made thin by die-casting processing with 2-3 mm.

[0016]The weld zone 6 welds the right margin of heart of the peripheral wall part 7 of the peripheral wall member 3 and a left brink, and the periphery edge of the end wall part 11 of each end-wall members 4 and 5. As mentioned above, the inside diameter of the becoming liner 2 is 250-450 mm, and an overall length is 500-1000 mm. The thick thin liner 2 cannot bear the internal pressure which reaches alone also more than 200 kg/cm^2 like this embodiment, therefore a main function is a duty of a core when twisting prevention and glass fiber of a penetration of CNG gas.

[0017]The double reinforcement layers 17 and 18 are formed in the periphery of the liner 2. That is, as the end-wall members 4 and 5 of both sides are started glass fiber, while twisting in the length direction of the peripheral wall member 3, the helical volume reinforcement layer 17 made from FRP which carries out impregnating immobilization with an epoxy resin is formed in the periphery of the liner 2. While twisting glass fiber around the periphery direction of the peripheral wall member 3, the hoop volume reinforcement layer 18 made from FRP which carries out impregnating immobilization with an epoxy resin is formed in the periphery of the helical volume reinforcement layer 17. Formation of each reinforcement layers 17 and 18 is carried out to the periphery of this liner 2 by twisting around the angle which can demonstrate the strength property of glass fiber effectively uniformly [glass fiber / to which the epoxy resin was made to adhere], rotating the liner 2 in the required direction in support of said base part 12 and the boss section 15. The thickness of each reinforcement layers 17 and 18 is 3-7 mm.

[0018]Since the liner 2 was made into connection structure with the end-wall members 4 and 5 by which die-casting processing was carried out with the peripheral wall member 3 by which is not integral construction like before and extruding was carried out according to the pressure vessel 1 of this embodiment, the processing method for which it was suitable for each part can be applied, and an installation cost and a conversion cost can be reduced. Thereby, the pressure vessel 1 can be manufactured cheaply and it can contribute to the spread of CNG vehicles.

[0019]As aforementioned, the peripheral wall member 3 and the end-wall members 4 and 5 can make thickness thin, and can fully be compensated with both the reinforcement layers 17 and 18 to internal pressure. Thereby, the weight of the pressure vessel 1 can be reduced and fuel consumption and weight balance when carried in a car can be raised.

[0020]Next, drawing 6 shows the important section section of the pressure vessel 20 of a second embodiment, and is different from a first embodiment only in the point which consists only of the three

rib boards 9 which the reinforcing rib part 8 of the peripheral wall member 3 was allotted to the section radial, and the inner end unified. Next, drawing 7 shows the important section section of the pressure vessel 22 of a third embodiment, and is different from a first embodiment only in the point which consists of the six projected rim ribs 23 which the reinforcing rib part 8 of the peripheral wall member 3 was allotted to the section radial, and projected short to the inner skin of the peripheral wall part 7. The same effect as a first embodiment is acquired also with the pressure vessels 20 and 22 of these second or third embodiments.

[0021]In the range which is not limited to the composition of said embodiment, for example, does not deviate from the meaning of an invention as follows, this invention can be changed suitably and can also be materialized.

(1) Change the size shape of each part. For example, it is good as for four or more in the rib board 9 or the rib part 13.

(2) Carry out as a pressure vessel for restoration of the various qualities of pressurized material other than CNG. For example, since in the case of LNG internal pressure is a 50 kg/cm^2 grade and internal pressure is a 35kg[/cm] ^{2} grade in the case of LPG, from said embodiment, an intensity design becomes easy and can be carried out easily.

[0022]

[Effect of the Invention]According to this invention, the outstanding effect that a lightweight pressure vessel can be manufactured easily and cheaply is done so as explained in full detail above.

[Translation done.]